

## CRYPTOGAMS-RICH NANOTHEROPHYTIC VEGETATION ON TRAVERTINE OUTCROPS NEAR TIVOLI.

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**ABSTRACT** - An interesting community, *Chaenorhino rubrifolii-Saxifragetum tridactylites* ass. nova, referable to *Alysso-Sedion albi* is described from Bagni di Tivoli, near Rome. This community is very restricted, and occurs on travertine outcrops on extremely thin soil. Its composition is characterised by a rich cryptogamic layer, with interesting species such as *Psora decipiens* and *Anoetangium aestivum*, and a sparse herb layer composed by minute therophytes, such as *Saxifraga tridactylites*, *Erophila verna*, *Chaenorhinum rubrifolium*. The community is severely threatened and more effective measure of protection should be enforced on the area.

**KEY WORDS** - *Koelerio-Corynephoretea*, phytosociology, priority habitat

### INTRODUCTION

The "Platea dei Tartari" is a large outcrop of travertines near Tivoli, a small town about 30 km from Rome. These travertines are valuable stone for constructions, so most of the area has been mined. A small site, close to the thermal baths of Bagni di Tivoli nonetheless preserve an extension of semi-natural vegetation. The floristic significance of this area has been since long underscored by Montelucci (1976-77). In this area rare species such as *Andrachne telephioides* and *Chaenorhinum rubrifolium* occur. Most of the area is heavily disturbed, due to soil shuffling and heaps of rubbles from nearby settlements; nonetheless, amidst this landscape a few small outcrops of almost bare travertine appear, where a flora of tiny therophytes (*Erophila verna*, *Saxifraga tridactylites*, *Minuartia mediterranea*, *Silene conica*, *Chaenorhinum rubrifolium*) together with a rich cryptogams layer (*Anoetangium aestivum*, *Schistidium* cfr *apocarpum*, *Psora decipiens*) thrives. Physiognomy and floristic composition are typical of the class *Koelerio-Corynephoretea* Klika in Klika et Novak 1941 (= *Sedo-Scleranthetea* Br.-Bl. 1955), a class characteristic of dry and warm habitats on shallow soils in Central Europe, that in the Mediterranean is vicaried by *Stipo-Trachynetea distachyae* Brullo 2001 and *Helianthemetea guttatae* Br.-Bl. 1964. The three classes show nonetheless important floristic relationships.

This habitat, apart from the scientific interest, is priority under the Directive Natura 2000, and led to the recognition of the area of Bagni di Tivoli as subjected to particular protection (Fig. 1).

Aim of this study is to present a description of the vegetation of this travertine outcrops.

#### STUDY SITE

Substrate in Bagni di Tivoli is composed of hydrothermal travertines (Bigi et al., 1988) These travertines are of recent origin (Pleistocene-Holocene).

Climate is Mediterranean with a short drought season. A few climatological characteristics are given in Tab 1 (and Fig. 2). Climate is slightly rainier than in Rome (about 700 mm) but the arid period is slightly longer.

The landscape of “Platea dei Tartari” near Bagni di Tivoli is strange and typical. It is a large plane outcrop of travertines, formerly in part cultivated as olive groves and now abandoned, with a regrowth of sparse bushes of *Styrax officinalis* (probably introduced), *Cercis siliquastrum*, *Phillyrea latifolia*, *Pyrus amygdaliformis*, and abundant populations of *Euphorbia characias*; this vegetation is similar to the Dalmatian Shijbljak.

#### METHODS

15 relevés have been carried out from 1994 to 2006 in communities with *Saxifraga tridactylites* and *Erophila verna*. A particularly thorough investigation has been carried out in Tivoli, but relevés also from Cimitero Verano in Rome and other sites in the surroundings of Rome have been considered. These two species are very frequent in Latium, but usually they do not co-occur, and impoverished populations that occur commonly in particular along roads and paths have not been considered in this

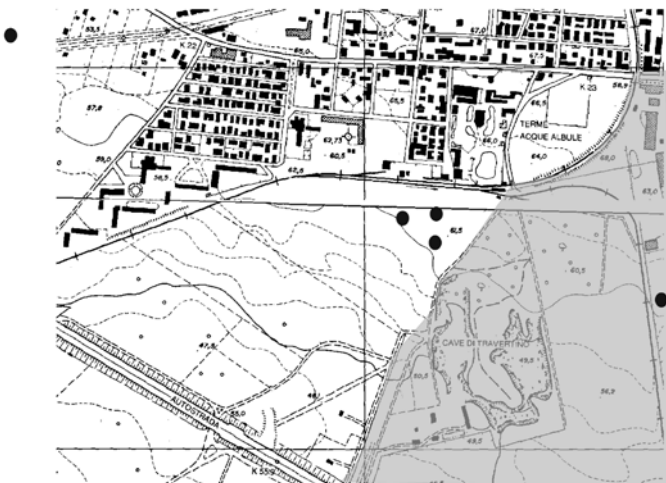


FIGURE 1 - study site; circles represent relevés, in grey the area protected.

TABLE 1 - Climatological characteristics of the meteorological station of Guidonia (after Blasi, 1994).

Average minimum temperature (°C)	9.9
Average yearly temperature (°C)	15.6
Average yearly precipitations (mm)	829

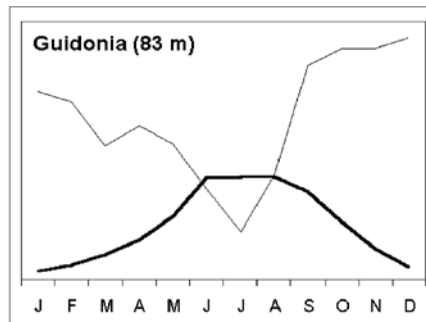


FIGURE 2 - Ombrothermic diagram of Guidonia (after Blasi, 1994)

study. Relevés have been ordered with TWINSPLAN and the resulting table has been rearranged manually. 7 relevés have been already presented (Fanelli, 2002, tab. 38) and are represented by frequencies.

## RESULTS

The community occurs on horizontal rock outcrops, where it occupies small stands (rarely more than 1 m<sup>2</sup>) on bare travertine outcrops; where the soil is even modestly developed, this community is replaced by different therophytic communities referable to Stipo-Trachynetea distachyae (with species such as *Linum strictum*, *Plantago lagopus*, *Trifolium cherleri*, *Medicago minima*). The species of these latter communities are differential of several associations of Koelerio-Corynephoretea in Central Europe, whereas in the Mediterranean they do not enter in the composition of the community object of this study. The physiognomy is typical of Koelerio-Corynephoretea, with an almost continuous, very low, moss and lichen layer among which are dispersed ephemeral therophytes not taller than a few cm. These small species usually flower in April, and in full spring disappear. Due to the slow growth of the prevalingly stress-tolerant cryptogams, this community is probably very sensitive to disturbance (f.i. trampling).

The community is quite species-poor, but very characterised and interesting. The main species are ephemeral therophytes: *Chaenorhinum rubrifolium*, *Minuartia mediterranea*, *Erophila verna*, *Saxifraga tridactylites*, etc. The two former are rare in Latium, whereas the latter is widespread and occurs usually in fragmentary almost monospecific populations associated with a different range of mosses, mainly *Pleurochete squarrosa*. The cryptogamic flora is very interesting, with xerophilous mosses such as *Anoetangium aestivum*, *Schistidium* cfr *apocarpum*, *Trichostomum crispulum*, and lichens such as *Psora decipiens* and *Toninia* sp..

Rel. 1 is slightly differentiated. Only here *Psilurus aristatus* and *Herniaria glabra* are present, whereas the rich cryptogamic layer lacks.

Rel. 6-8 are from sites other than Tivoli. These relevés are intermediate with the relevés found in Verano (Col. 9); the moss layer in fact is composed mainly of the more ruderal *Pleurochaete squarrosa*; species of *Koelerio-Coryneporetea* are less well represented, and a number of species from arid grasslands occur among the sporadics.

The floristic composition of community is sufficiently distinct to deserve the description of a new association *Chaenorhino rubrifolii-Saxifragetum tridactylitis* Fanelli *hoc loco* (typus Tab. 2, rel. 4). From a syntaxonomical point of view the association can be easily referred to *Alysso-Sedion albi* Moravec 1967, because of the presence of *Erophila verna*, *Campanula erinus*, *Saxifraga tridactylites*, although perennial species (*Sedum album* ecc.) usually accompanying the associations of *Alysso-Sedion* in Central Europe (Oberdorfer, 1978) are lacking. Other species too, such as *Silene conica*, *Cerastium semidecandrum*, *Satureja acinos* are typical of *Koelerio-Coryneporetea*.

An interesting aspect of the flora of this biotope are the affinities with dunal environment. A few species typical of dunes of central Latium, such as *Senecio leucanthemifolius*, are abundant. This should not be unexpected, since communities of *Koelerio-Coryneporetea* colonise extensively sand dunes in central Europe. Curiously, also the pulmonate fauna accompanying this community is the same commonly encountered on sand dunes in Latium (*Theba pisana*, *Cochlicella conoidea*, *Cochlicella barbara* etc.). This mollusc community has been described sometimes as *Thebetum pisanae* (Sacchi, 1952).

On gravestones in the Cimitero Verano, in Rome, a very typical community occurs (Fanelli, 2002) that has many species in common with the association of Tivoli. The most significant, strongly stress-tolerant species are lacking (*Chaenorhinum rubrifolium*, *Minuartia mediterranea*), and a large number of small species of *Stellarietea* are present. Also the moss flora is completely different, with the xerophilous mosses of Tivoli replaced by ruderal and less xerophilous species (*Pleurochete squarrosa*, *Eurynchium pumilum*, *Barbula unguiculata*). Nonetheless, the affinities with the association in Tivoli are evident. It is a striking case of “ruderalisation” of a vegetation type. The disappearance of stress-tolerant therophytes and cryptogams and the appearance of a large number of ruderal therophytes and a few ruderal cryptogams is a pattern frequent in urban plant communities. The community is enough different in overall floristic composition that it would be not insensible to consider as a distinct one; nonetheless it's poor floristic characterisation, very local occurrence and clear affinities with the community in Tivoli suggest to treat this association as a subassociation of *Chaenorhino rubrifoliae-Saxifragtetum tridactylitis*. This subassociation is intermediate between *Koelerio-Coryneporetea* and *Stellarietea mediae*.

*Chaenorhinum rubrifolium* is indicated as character-species of a few associations referred to *Sedo-Ctenopsion gypsophylae* Rivas Goday 1964, an alliance described for chalks in Central Spain (Izco, 1974, Izco *et al.*, 1986) and thereafter retrieved in Sicily (Brullo *et al.*, 1989). Otherwise the floristic composition is completely different, with a clear affinity for *Stipo-Trachyneteta distachyae*. (*Hippocrepis multisiliquosa*, *Linum strictum*). Nonetheless a number of xerophytic species (*Sedum gypsicola*, *Minuartia hamata*, *Vulpia unilateralis*, *Hornungia petraea*, *Bombycilaena erecta*, *Crucianella patula*, *Erodium laciniatum*, *Campanula erinus*) typical of the gypsum flora of Central Spain are perhaps more related to the vegetation of *Koelerio-Coryneporetea* than to typical *Stipo-Trachyneteta*.



TABLE 2 – Table of relevés (continued)

<b>other cryptogams</b>								
Bryum caespiticum	.	+	+	.	.	.	.	14
Psora decipiens	.	+	.	.	2	.	.	.
Schistidium cfr apocarpum	.	2	.	.	.	.	.	.
Fulgensia fulgens	.	+	.	.	.	.	.	.
Toninia sp.	.	+	.	.	.	.	.	.
Collema sp.	.	.	.	.	2	.	.	.
Pleurochaete squarrosa	3	.	.	.	4	3	4	5
Lunularia cruciata	.	.	.	.	.	.	.	.
Barbula unguiculata	.	.	.	.	.	.	.	.
Eurynchium pumilum	.	.	.	.	.	.	.	.
Bryum donianum	.	.	.	.	.	.	.	14
Scorpiurum circinatum	.	.	.	.	.	.	.	28
Cladonia foliosa	.	.	.	.	.	.	+	.
<b>companions</b>								
Vulpia ciliata	.	.	.	.	+	.	.	28
Catapodium rigidum	+	.	.	.	+	.	+	.
Helianthemum salicifolium	.	+	.	.	+	.	.	.
Sherardia arvensis	.	.	.	.	.	.	+	+
Hypochoeris achyrophorus	.	.	.	.	.	.	2	+
Aphanes pusilla	.	.	.	.	.	.	.	+
Poa annua	.	.	.	.	.	.	.	57
Galium murale	.	.	.	.	.	.	.	57
Parietaria judaica	.	.	.	.	.	.	.	71
Polycarpon tetraphyllum ssp. tetraphyllum	.	.	.	.	.	.	.	71
Crepis bursifolia	.	.	.	.	.	.	.	42
Sagina apetala	.	.	.	.	.	.	.	42
Sonchus tenerrimus	.	.	.	.	.	.	.	28
Taraxacum officinale aggr.	.	.	.	.	.	.	.	42
Andryala integrifolia	.	.	.	.	.	.	.	14
Oxalis dillenii	.	.	.	.	.	.	.	28
Picris echioides	.	.	.	.	.	.	.	14
Cichorium intybus	.	.	.	.	.	.	.	28

## DISCUSSION

The class *Koelerio-Corynephoretea* occurs on sand dunes and on rock outcrops on very shallow soils in Central Europe, often in pioneer habitats. The limits with the Mediterranean nanotherophytic vegetation are clearcut, nonetheless the position for instance of alliance *Thero-Airon* Tüxen et Oberd. 1957 is debated, either in

*Koelerio-Corynephoretea* (Oberdorfer, 1978) or *Helianthemetea guttatae* (Rivas-Martinez *et al.*, 1997); moreover, many species diagnostic of *Stipo-Trachynetea distachyae* in the Mediterranean are character-species of *Koelerio-Corynephoretea* in Central Europe (Braun-Blanquet *et al.*, 1952). Probably a good distinctive character of *Koelerio-Corynephoretea* with respect to Mediterranean nanotherophytic vegetation is the important presence of cryptogams in the former. In fact, many, but not all, communities of *Koelerio-Corynephoretea* show a well developed cryptogams-layer, that in a few cases is dominant over the phanerogamic layer, whereas cryptogams are usually absent in *Stipo-Trachynetea* and *Helianthemetea guttatae*. *Chaenorhino-Saxifragetum* is interesting in this respect, because in the landscape of "Platea dei Tartari" a careful study shows that the floristic pool of *Koelerio-Corynephoretea* (*Chaenorhino rubrifolium*, *Sedum hispanicum*, *Erophila verna*, *Saxifraga tridactylites*, etc.) is well separated from the floristic pool of *Stipo-Trachynetea distachyae* (*Trifolium scabrum*, *Medicago minima*, *Linum strictum*, etc.). The former occur together with many mosses and lichens on bare stone, the latter on shallow soils and is not accompanied by cryptogams. Since *Chaenorhinum rubrifolium* is reported in the associations of *Sedo-Ctenopsion* (*Stipo-Trachynetea distachyae*), although with a floristic composition actually referable to the Mediterranean nanotherophytic vegetation and not to Central European nanotherophytic vegetation, it would be interesting a closer study of the transition between these classes in Central Spain.

Although the phanerogams typical of *Chaenorhino-Saxifragetum* are ephemerals, the cryptogams are probably very slow growing and therefore typical stress-tolerant. Their persistence is related to small undisturbed spots, a condition possible in the heavily urbanized landscape of Tivoli because the nearby railway secludes the area where the association occurs and therefore strongly reduces frequentation. Even moderate disturbance, such as in Verano, leads to a ruderalisation of this vegetation type, with a complete floristic turnover of mosses and disappearance of lichens.

#### PROTECTION MEASURES

Part of the area of this study is classified as SIC (ITS6030033) under the UE Directive Habitat, for the presence of the priority habitats 6110 (*Alyso-Sedion albi*) and 6229 (*Thero-Brachypodietea*). This classification is among the most effective measure of protection in the UE. Unfortunately, in the definition of boundaries of SIC a large part of the area has been left unprotected, and this area is where the most typical relevés of *Chaenorhino-Saxifragetum* occur (Fig. 1). Moreover, this unprotected area is heavily threatened because in the immediately surrounding areas building projects are under course, and the area is used to dispose of rubbles and earths.

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## APPENDIX I: SITES AND DATES:

REL. 1: BAGNI DI TIVOLI (33TUG115452), 21/4/6; REL. 2: BAGNI DI TIVOLI (33TUG111468) 21/4/06; RIL 3: BAGNI DI TIVOLI (33TUG111468), 21/4/06; REL. 4 BAGNI DI TIVOLI (33TUG111468) 21/4/06; REL. 5: BAGNI DI TIVOLI (33TUG110469) 27/5/06; REL. 6: CASTEL FUSANO (33TTG757258) 20/3/02; REL. 7: M.TI PRENESTINI (33TUG322469) 12/3/02; REL. 8: DECIMA (33TTG888200) 7/3/02

## APPENDIX II: SPORADIC SPECIES:

REL. 1: *CONVOLVULUS CANTABRICA* (2), *ROSTRARIA CRISTATA*, *MINUARTIA HYBRIDA*, *PSILURUS ARISTATUS*, *HERNIARIA GLABRA*; REL. 2: *PLANTAGO AFRA*; REL. 5: *ANTHEMIS ARVEN-SIS* SUBSP. *INCASSATA*, *CREPIS NEGLECTA*, *PETRORHAGIA SAXIFRAGA* SUBSP. *SAXIFRAGA*, *SCANDIX PECTEN-VENERIS*, *SENECIO LEUCANTHEMIFOLIUS*; REL. 6: *LATHYRUS CLYMENUM*, *ROSTRARIA LITOREA*, *TEUCRIUM CHAMAEDRYIS*, *CENTAUREA SPHAEROCEPHALA*, *VICIA PSEUDOCRACCA*, *VULPIA ALOPECURUS*; REL. 7: *PLANTAGO LAGOPUS*, *POA BULBOSA*, *SIDERITIS ROMANA*, *TORDYLIUM APULUM*, *UROSPERMUM DALECHAMPII*, *MUSCARI NEGLECTUM*; REL. 8: *ASPHODELUS RAMOSUS*, *CERASTIUM LIGUSTICUM*, *PLANTAGO BELLARDI*